

most excellent in their way ; but as generally taught, they are too desultory and unsystematic to effect fully their intended purpose. The principal manuals on the subject show a want of arrangement and system, that greatly detracts from their value. One day the children are supposed to learn a lesson on a piece of iron : the next on a flower, the third on a shell, and so on. Too much stress is laid upon cultivating the powers of observation, and too little on connecting the facts observed, and drawing conclusions from them. The lessons, too, are very frequently unconnected with each other, and the facts taught lean almost too much towards the practical and economic side of knowledge, and too little to that of systematic science. Great scientific ignorance is displayed in many cases : for instance, one book informs us that plumbago is an ore of iron ; that iron is generally found as an oxide in combination with *sulphuric* and carbonic acid ; that fluor spar is composed of fluoric acid and lime ; and that lime unites with various proportions of carbonic acid. These mistakes are the result of imperfect scientific knowledge, and may be passed over for the sake of the valuable instruction given to teachers, which cannot fail to produce most excellent results, if applied to systematic scientific teaching.

It may be urged that children of 8 or 9 are too young for systematic science teaching, but facts prove the contrary. An ordinarily intelligent boy or girl of this age is perfectly capable of understanding the broad differences between the animal, vegetable, and mineral kingdoms ; that there are more gases than one in the world ; that some of them are colourless, while others are brown or green ; that some burn and others do not ; that some plants grow from the inside, while others grow from the outside ; that some animals have jointed backbones, that others have their bones outside their bodies, while others have none at all. Facts such as these are perfectly comprehensible to children even younger than those I have named. During the first two years of a child's school life, after he has learned to read and write, he should be carried through the whole range of physical science in a systematic manner. The fundamental truths of chemistry and physics should be first taught him : all theoretical considerations being left aside. As few definitions as possible should be given, the whole task of the teacher at the commencement being to cultivate the child's powers of observation to the utmost. Gradually the powers of induction and deduction may be developed, facts and phenomena should be compared, and conclusions drawn from them. Order in thought and description should be specially insisted upon, and occasional retracings of the ground already gone over should take place. The objects of this preliminary science teaching should be twofold : first and foremost, to train the mind and form the judgment ; and secondly, to give the child a general idea of the object and scope of the natural sciences. At the age mentioned, the faculties are all fresh, and in full process of development ; and such is the desire to exercise them in intelligent children, that their thoughts often run wild. There is nothing a child likes so much as investigation, or "finding out all about things," as he himself would phrase it. The boy in the nursery rhyme who cut the bellows open to see where the wind came from, is a type of his class. Unfortunately at the present time, scientific teachers for children are

extremely rare, but let the want once arise, and the demand will soon be met. We have plenty of scientific teachers and lecturers for boys and men, but the child has hitherto been left out of consideration. Teachers, in the true sense of the word, are every day on the increase, and even the old-fashioned schoolmasters are beginning to see very plainly that they must alter their system of instruction, and yield to the pressure of the times. But it is not only upon these that I would urge the necessity of beginning science teaching at the earliest possible period, but also upon those who have already adopted science as part of the ordinary school curriculum for the older boys.

CHARLES W. QUIN

THE GOLD FIELDS OF VICTORIA

The Gold Fields and Mineral Districts of Victoria. By R. B. Smyth. (Melbourne : J. Ferres. London : Trübner and Co.)

I

TWENTY short years ago, the territory of Southern Australia comprised within the colony of Victoria offered comparatively little attraction to the emigrant. Its population had increased but slowly during the half century which had passed away since the discovery of Port Phillip Bay. Graziers, shepherds, and farmers were its chief occupants, and by them the value of its soil was estimated very much according to the number of cattle or of sheep which each acre could maintain. But to-day everything is changed. The land is dotted with hamlets, villages, and towns, and is intersected with roads and railways. The population has increased from 77,000 in 1851, to 660,000 in 1867. In the former year only 57,000 acres were under cultivation, in the latter the area had risen to 631,000. This growth in the population has been accompanied by a corresponding increase in the value of the imports and exports, which are now ten times what they were ; while the value of rateable property in town and country districts is estimated at about £42,000,000.

This marvellously rapid rise of the colony is mainly to be ascribed to the discovery of gold there in 1851. Never had the prospects of the colony been gloomier than just before that discovery was made. The able-bodied part of the population was moving off to the gold-fields of New South Wales, glowing accounts of which appeared from week to week in the newspapers. Every kind of property was sinking in value. At last, after small finds of gold had been reported from different parts of Victoria, a public meeting of the citizens of Melbourne was convened, for the purpose of raising funds towards offering a reward to any one who should discover a workable gold mine within twenty miles of that town. The attention of the colonists was now thoroughly roused, and in the course of a few weeks reports came from many of the surrounding districts that gold existed in large quantities. From that time the tide of emigration from the colony was arrested, and the population began to increase with that wonderful rapidity just alluded to.

From the very beginning of the mining operations they were regulated and inspected by the Colonial Government. A mining department was instituted, with a responsible minister at its head. Mining registrars and surveyors, wardens of mining districts, and other officials were appointed with the view of aiding and regulating the labours.

of the miners, and collecting every variety of information for the use of the Government. More than this, a geological survey was established, under the direction of one of the ablest of the staff of the Geological Survey of the United Kingdom, Mr. Selwyn; and funds were furnished for the production of maps, sections, and other publications necessary for elucidating the geological structure of the colony. That survey has done excellent work, the real value of which may possibly not be understood in the colony for some years to come. We cannot but regret, therefore, that in a spirit of parsimony the colonial Parliament has recently abolished the survey, and deprived the colony of the great advantage of obtaining accurate information as to the mineral tracts which remain yet to be explored. Nevertheless, for what has already been done to develop her mineral resources, and to gather accurate information regarding the structure of the rocks, and the distribution of gold, the colony may be very heartily congratulated.

The handsome volume, whose title heads this article, tells the story of the rapid rise of Victoria. It is a large thick octavo, beautifully printed, and embellished with many woodcuts, sections, and plans of singular excellence, the whole having been prepared and executed in Melbourne. Mr. Brough Smyth, Secretary for Mines to the colony, seeing the want of any trustworthy account of the gold-fields of that region, and having himself peculiar advantages for the task, proposed to himself to compile a narrative of all that was known regarding the mineral districts, the different modes in which the gold occurs, and the various methods in use for obtaining it. He has carried out the project with most commendable patience, and has produced a volume about the Victorian mines which is itself quite a mine of information both to the practical digger and to the geologist.

After a brief introduction, in which the author traces the successive steps which led to the commencement and prosecution of his work, he sketches the general topographical and geological features of the mineral districts. He then briefly describes the circumstances attendant on the first discovery and earliest mining of gold in Victoria, and passes on to treat of the different modes in which the gold occurs. The older or basement rocks are of palæozoic age. They are plicated and denuded very much like our own Silurian strata in Wales, Cumberland, and Scotland. They are, as a whole, but little altered, consisting in large measure of sandstones, mudstones, and shales, which now and then pass into harder and somewhat schistose varieties. Across these strata run thousands of quartz veins, which vary in thickness from one-sixteenth of an inch to 100 and 150 ft. Although gold has been found in small quantity disseminated between the planes of bedding of the sandstones, it is in these quartz veins that it chiefly occurs *in situ*. It takes many forms—fine flakes or grains floating, as it were, in the quartz, ramifying threads or moss-like aggregations, spangles, thin plates like gold-leaf, well defined crystals, irregular strings, rough lumps, and large nuggets. How the gold got into the veins is a question on which Mr. Brough Smyth brings forward much argumentation from different writers holding discordant views, but which he does not himself attempt to solve.

Overlying the palæozoic rocks with their quartz veins

are "drifts" and alluvial accumulations of different ages. These are very generally auriferous, the gold occurring in detached fragments, varying in shape and size from mere dust up to masses like the "welcome stranger nugget," which weighed upwards of 2280 ounces. There are features of special geological interest in these alluvia, which will be noticed in a second article. The very soil is sometimes full of gold, particularly where it overlies, or slopes from, a quartz-reef. In one place a patch of such soil, about twelve feet square and one foot deep, yielded 30 ounces of gold, even with such rude processes of extraction as were in use in the early days of the gold-fields.

Mr. Smyth arranges the different methods of working gold as follows:—

- "(1) *Surfacing*—the washing of the thin covering of earth resting on the tops and sides of the hills in the close neighbourhood of auriferous quartz veins.
- (2) *Shallow-sinking*—the obtaining *washdirt* from off the surface of the old claystones, sandstones, and slates, by sinking pits, or making excavations in the valleys and creeks.
- (3) *Sluicing and hydraulic mining*—the washing of the auriferous earths, by streams of water, in the gulleys and valleys where recent deposits of auriferous gravels and clays occur.
- (4) *Deep sinking*—the obtaining auriferous earths by penetrating the deeper tertiary.
- (5) *Tunnelling*—the obtaining auriferous earths and veinstones by adits.
- (6) *Quartz-mining*—the obtaining gold from the mineral veins intersecting the older sedimentary rocks."

The author gives copious details of these different processes as carried on in the various claims and fields. Much of the information so given has necessarily but a local interest, yet its compilation into the present accessible form cannot but prove of much service to those practically engaged in gold-mining in the colony. Some idea of the richness of the Victorian gold-fields may be obtained from the fact that from the first discovery of the precious metal in 1851, up to the end of last year, there had been obtained 36,835,651 $\frac{3}{4}$ ounces, estimated as equal to £147,342,767. In the year 1854, just three years after the first discovery of gold, and when the gold-fever was at its height, the number of miners was 65,763. Since that time the numbers have slowly diminished, and in September, 1868, they stood at 63,482. There has been a still more marked diminution in the amount of gold reported. In 1856, the quantity sent out of the colony reached to 2,985,991 ounces, while last year it was only 1,657,498 ounces.

Besides gold, Victoria furnishes other valuable mineral resources. Ores of silver, tin, copper, antimony, zinc, lead, cobalt, bismuth, manganese, and iron occur, some of them in great abundance. Coal, lignite, and bituminous shales are likewise met with; while among the mineral produce of the colony are likewise enumerated the sapphire and the diamond.

The author's official position as Secretary for Mines afforded him excellent opportunities for collecting information regarding the mines in every part of the colony. But such official experience does not necessarily bring with it any practical knowledge of mining, still less any

acquaintance with the geological facts which guide mining operations. Mr. Smyth modestly says of himself: "I wish it to be distinctly understood that I am merely a compiler." But his book abundantly proves that he has a thorough knowledge of what practical mining is, and that he is no mere tyro in geology. A tolerably good test of the accuracy of a man's geological knowledge is often furnished by the way in which he draws a section. He is compelled to put down definitely the notion which he has formed of the structure of a district, or of the relations of certain rocks to each other, and the manner in which he does this may be usually regarded as an indication of the extent of his acquaintance, not merely with the locality in question, but with the fundamental laws of geological structure. At the same time, too, he unconsciously betrays whether or not Nature has gifted him with any trace of the artistic faculty. Now Mr. Smyth's sections are singularly excellent. He procured them from miners, mining companies, geologists, and private friends, and no doubt, in many cases, from his own observations. Everybody who has ever tried to collect sections in this way knows that they come in every conceivable style and scale, usually grossly exaggerated either in length or height. Such were doubtless the sections which arrived at the Victorian Office of Mines. But Mr. Smyth has recast them after his own pattern, and they now appear in a uniform kind of drawing, which reminds one of the artistic finish introduced many years ago into geological section-drawing by the late Sir Henry De la Beche.

It is hardly possible to over-estimate the advantages which must accrue to mining interests in the colony when the Government department of Mines possesses a secretary who is evidently most thoroughly in love with his work, and who is endowed with so much sound scientific knowledge and experience. This book is an eminently practical one. Yet it offers every now and then glimpses into geological questions of the highest interest. To some of these reference will be made in a subsequent article.

ARCH. GEIKIE

OUR BOOK SHELF

Terrestrial Physics.—*Probleme der vergleichenden Erdkunde.* By Oscar Peschel. (Leipzig, 1870.)

THE fundamental thesis of the author, involving his conception of the true province of the science of comparative terrestrial physics, appears to be this:—If a series of maps of the globe, or any part of it, drawn at different times during several centuries, be compared, there becomes obvious a radical want of truthfulness in the older representations; such coast-lines, such mountain-chains, such river-courses are utterly impossible. On the other hand, a modern map convinces us at once of its internal truth. This truth must be founded on some general laws, which must be discoverable by studying the resemblances in the external features of countries; and finally a series of such resemblances distributed over different localities must lead to the discovery of the conditions of their origin.

One example, taken at random, will be sufficient to indicate the author's method of procedure. A comparative study of the localities, where fiords occur, shows—(1) that they are mostly to be found on west coasts, and appear generally associated, rarely single; (2) that they are limited to high latitudes, and excluded from the region confined on both sides of the equator by the isothermal line of 10° C.; (3) that they are all within the region of rainfall during the whole of the year. Hence the general

law is deduced, that fiords owe their origin principally to certain climatic conditions, viz. a low temperature, a maximum amount of aqueous deposition, and protection from the drying influence of easterly winds.

Now, we can well admit the possibility, or even probability, that continued actual observations may lead to similar conclusions; but in the mean time we are at a loss to understand how rain or isothermal charts, representing most recent conditions, can be applied to explain phenomena which the author himself thinks must have happened so long ago, that the time would have to be reckoned by hundreds of thousands of years.

M. Peschel, as it appears from his own admissions, has never left his study to observe the phenomena on which he reasons. He has collected, extracted, compiled, compared, and—generalised. This is not the legitimate approach to Nature's secrets, and consequently the author's work, although written in a masterly style, leaves us comparatively in the dark. It is the ingenious pleading of a lawyer for the cause he has undertaken, rather than the transparent and triumphant language with which the genuine student of Nature proclaims his discovery to the world.

B. L.

Cinchona Plantations in Java. *Die Chinacultur auf Java.* Von J. W. Van Gorkom, ans dems Hollandischen übertragen von C. Hasskarl. (Leipzig, 1869.)

THE efforts of the English Government to establish the quinine-producing plants of South America in our Indian possessions have excited very general interest. Other European Governments are, however, not less alive than our own to the danger of depending any longer solely upon the chance products of the forests of South America for supplies of the most indispensable of medicines. Our neighbours, the Dutch, have for more than twelve years devoted much attention to the regular cultivation of cinchona trees in Java, and although the results obtained hitherto are not so favourable as we should have hoped, there is good reason to believe that the experience now gained will lead to great success in the future. The scale on which the Dutch experiments are being made will be best indicated by the fact that on the 31st March last there were in Java in nurseries and regular plantations nearly a million cinchona plants under cultivation. Besides these; more than 900,000 have been planted in the jungles, but have, unfortunately, owing to a variety of causes, already mostly disappeared. In the present pamphlet M. von Gorkom gives the experience of the Dutch cultivators, as well as a general review of the literature of the subject. Appended to the pamphlet are tables showing the present state of cinchona-culture in Java, the rate of growths of the plants, and the results of chemical analyses of the various species cultivated. Monsieur van Gorkom has had the advantage of having his work rendered into the more generally accessible German language, by a gentleman who has himself taken so distinguished a part in cinchona-culture as to induce a jury of the French International Exhibition of 1867 to confer a gold medal upon him, while assigning to Markham, McIvor, and others silver medals only.

Transactions of the Bremen Scientific Association.—*Abhandlungen des naturwissenschaftlichen Vereins zu Bremen.* Vol. 2. part i. (Bremen, 1869.)

An article by Dr. Foske on the late Professor Trevirarus points out that in some of his works the fundamental ideas of Darwinianism were clearly expressed, long before the theory was explicitly propounded by Mr. Darwin.

We would direct the attention of biologists to a paper in the same volume, by M. Luerksen, "On the influence of red and blue light on the plasma-stream in the hairs of *Urtica* and *Tradescantia virginica*." It appears that the action of red light is to disturb the molecular structure of the protoplasm, and finally to destroy it entirely, while blue and white light act similarly; the blue, however, with somewhat less energy.

B. L.